

**REMARKS**

Applicants have amended their claims in order to further clarify the definition of various aspects of the present invention. Specifically, Applicants have incorporated the subject matter of claim 2 into claim 1; and, correspondingly, have cancelled claim 2 without prejudice or disclaimer. Applicants have further amended claim 1 to recite a CMP abrasive for polishing an insulating film having unevenness on a surface thereof; and, in defining the components of this abrasive, to recite an organic polymer having an atom or a structure capable of forming a hydrogen bond with a hydroxyl group present on a surface of "said" film to be polished (said film being the insulating film having unevenness on a surface thereof). Applicants have amended preambles of each of claims 3-9 in order to recite the CMP abrasive "for polishing an inorganic insulating film having unevenness on a surface thereof", consistent with claim 1 as presently amended; have further amended claim 8 to recite an upper limit of the weight average molecular weight of "1,200,000", and to correct a typographical error; and have further amended claim 9 to recite that the abrasive includes the specified amount of "a" dispersant, and to recite a range (0.001 "to" 1000 parts by weight) for amount of organic polymer.

Applicants have amended withdrawn claim 10 to recite "an inorganic insulating film" to be polished, and have further amended claim 10 to recite the CMP abrasive "for polishing an inorganic insulating film having unevenness on a surface thereof" according to claim 1, consistent with the preamble of presently amended claim 1. Applicants have made similar amendments to withdrawn claim 11. In view of corresponding recitations in the claims being considered on the merits and claims 10 and 11, it is respectfully requested that the Examiner re-consider the restriction requirement and consider claims 10 and 11 on the merits herein.

Furthermore, in order to simplify proceedings, Applicants have cancelled claims 12-26 without prejudice or disclaimer, and in particular without prejudice to the filing of a Continuing application or applications in connection therewith.

Applicants are also adding new claims 27-30 to the application. Claims 27 and 28, each dependent on claim 1, respectively further defines the dispersant, and defines the weight average molecular weight of the organic polymer; and claims 29 and 30, each dependent on claim 1, respectively defines amount of organic polymer included in the abrasive, and recites that the abrasive "consists of" the cerium oxide particles, the dispersant, water and the organic polymer.

In view of the concurrent filing of the RCE Transmittal, it is respectfully submitted that the present amendments are to be entered in the above-identified application, notwithstanding the finality of the Office Action mailed March 15, 2006.

The withdrawal of claims 23 and 24 from consideration in the above-identified application is moot, in view of present canceling thereof without prejudice or disclaimer. Moreover, the objection to the Amendment filed December 15, 2005, under 35 USC §132(a), and the rejection of claims 25 and 26 under the first paragraph of 35 USC §112, set forth on pages 2-4 of the Office Action mailed March 15, 2006, are moot, in view of present canceling of claims 23-26 without prejudice or disclaimer.

Applicants respectfully submit that all of the claims presented herein for consideration by the Examiner on the merits patentably distinguish over the teachings of the reference applied in the Office Action mailed March 15, 2006, that is, the teachings of United States Patent Application Publication No. 2003/0181046 to Sachan, et al., under the provisions of 35 USC §102 and 35 USC §103.

It is respectfully submitted that the reference as applied by the Examiner would have neither taught nor would have suggested such a CMP abrasive for polishing an insulating film having unevenness on a surface thereof, as in the present claims, "consisting essentially of" the components recited in claim 1, including the organic polymer having an atom or a structure capable of forming a hydrogen bond with a hydroxyl group present on a surface of the (aforementioned) film to be polished, and wherein the organic polymer is a compound containing at least one atom having an unpaired electron in a molecular structure. See claim 1.

Furthermore, it is respectfully submitted that the applied reference would have neither disclosed nor would have suggested such CMP abrasive for polishing inorganic insulating films having unevenness on a surface thereof as in the present claims, having features as discussed previously in connection with claim 1, and, in addition, wherein the abrasive "consists of" the recited compositions (see claim 30); and/or wherein the organic polymer is a compound containing either one or both of nitrogen atom and oxygen atom in the molecular structure (see claim 3); and/or wherein this organic polymer is a compound having an adsorption ratio of at least 50% with respect to silicon oxide particles (see claim 4) or an adsorption ratio of at least 40% with respect to silicon nitride particles (see claim 5), where such particles are of a specific surface area dispersed in water of a specific pH; and/or wherein the organic polymer is polyvinyl pyrrolidone (see claim 7), having a weight average molecular weight as in claim 8; and/or wherein the organic polymer has a weight average molecular weight as in claim 28; and/or amount of organic polymer included in the abrasive, as in claim 29, or amount of dispersant, organic polymer, water and cerium oxide particles as in claim 9; and/or further definition of the dispersant as in

claim 27; and/or wherein the sedimentation speed of the cerium oxide particles is 20 $\mu$ m/s or less (see claim 6).

The invention as being considered on the merits in the above-identified application relates to a CMP abrasive, used in smoothing a surface of an inorganic insulating film (e.g., an interlayer insulating film) having unevenness on a surface thereof.

With current ultra-large scale integrated circuits, having increased packaging density, CMP technology has become more important for fully smoothing (e.g., planarizing) a layer, especially for planarizing an interlayer insulating film and a BPSG (Boron Phosphorus-doped Silicon Dioxide) film and performing shallow trench isolation. With conventional CMP technology for smoothing an interlayer insulating film, technical problems arise in that a high-level of smoothing can not be realized over an entire surface of a wafer, as described on the first paragraph on page 2 of Applicants' Specification.

Against this background, Applicants provide a CMP abrasive capable of polishing an inorganic insulating film surface to be polished (such as a silicon oxide or silicon nitride insulating film), having unevenness, at high speed, without causing scratches, while achieving a high level of smoothing. Applicants have achieved these objectives with a CMP abrasive according to the present invention, which also has excellent storage stability. Applicants have found that by including an organic polymer having an atom or a structure capable of forming a hydrogen bond with a hydroxyl group present on a surface of the film (having unevenness) to be polished, this organic polymer containing at least one atom having an unpaired electron in the molecular structure, in a polishing material also consisting essentially of, e.g., a dispersant and cerium oxide particles, and water, objectives according to the present

invention are achieved. That is, an insulating film such as a silicon oxide film or silicon nitride film can be polished with a high speed and a high level of smoothness, without scratches, achieving a manufactured product, using the polishing, in a high yield. In addition, the CMP abrasive according to the present invention has good storage stability. Note from page 24, line 31 to page 25, line 12, of Applicants' Specification.

Illustrative of the advantages achieved according to the present invention, attention is respectfully directed to the Examples and Comparative Examples on pages 13-24 of Applicants' Specification. As can be seen in the polishing speed ratios  $R_5/R_1$  and  $R_3/R_1$  in the Examples and Comparative Examples in the present Specification, these ratios were much closer to one for compositions according to the present invention (note Examples 1 and 2 on pages 13-21 of Applicants' Specification), as compared with polishing speed ratios for Comparative Examples 1 and 2 on pages 21-24 of Applicants' Specification. In particular, compare the polishing speed ratios for Examples 1 and 2, respectively set forth at page 18, lines 13-23 and page 20, line 26 to page 21, line 11; with the polishing speed ratios for Comparative Examples 1 and 2, respectively, at page 23, lines 7-20 and page 24, lines 13-20. As is clear from these Examples and Comparative Examples, unexpectedly better smoothing at higher polishing speeds, corresponding to the polishing speed ratios closer to 1, are achieved according to the present invention, including the organic polymer recited in the present claims, as compared with the Comparative Examples. It is respectfully submitted that this evidence of unexpectedly better results must be considered in determining patentability of the present invention (see In re DeBlauwe, 222 USPQ 191 (CAFC 1984)); and, properly considered, it is respectfully submitted that this evidence of unexpectedly better

results clearly supports a conclusion of unobviousness of the presently claimed subject matter.

While Applicants have relied on the evidence of unexpectedly better results in their specification, in the Amendment filed December 15, 2005, the Examiner has not commented on such evidence. Clearly, this evidence must be considered by the Examiner, in connection with any rejection under 35 USC §103. See Manual of Patent Examining Procedure (MPEP 716.01(a), where it is stated that:

“Examiners must consider comparative data in the specification which is intended to illustrate the claimed invention in reaching a conclusion with regard to the obviousness of the claims”.

It is emphasized that the present invention as claimed herein provides a CMP abrasive for polishing inorganic insulating films having unevenness on a surface thereof (e.g., projections and/or recesses on such surface), the abrasive including, in addition to, inter alia, cerium oxide particles, an organic polymer having an atom or a structure capable of forming a hydrogen bond with a hydroxyl group present on a surface of this film to be polished, and containing at least one atom having an unpaired electron in the molecular structure. Through use of this abrasive, an inorganic insulating film having unevenness on the surface thereof is polished, such that the unevenness is smoothed.

Sachan, et al. discloses techniques for polishing and planarization of integrated circuit surfaces, particularly those comprising a metal, a barrier layer and an insulating layer. This patent is primarily directed to such polishing which attenuates removal of the oxide film during metal CMP. This patent discloses that by including one or more organic polymers which attenuate removal of the oxide film,

the polymers having functional moieties interacting strongly with the silicon oxide surface so as to provide a protective layer that inhibits removal of the silicon dioxide film at appreciable levels, the metal and barrier layer can be polished without removal of the oxide film. Note paragraphs [0003] and [0013] - [0017] on pages 1 and 2 of Sachan, et al. This patent document further discloses that the slurries may optionally contain a dispersant, which dispersant can be anionic, cationic or nonionic. See paragraph [0019] on page 2 of this published patent application.

Initially, it is emphasized that Sachan, et al. is primarily concerned with polishing a metal layer while attenuating removal of the oxide film. In this regard, note that Sachan, et al. includes, inter alia, an oxidant to oxidize the metal, as well as a metal complexing agent. In contrast, according to the present invention an oxide film may be polished. It is respectfully submitted that Sachan, et al. would have neither taught nor would have suggested such abrasive or such additive as in the present claims, consisting essentially of the recited components.

Again, note that the composition of Sachan, et al., attenuates removal of the oxide film. Note, for example, paragraph [0006] on page 1 of Sachan, et al., disclosing that the removal rate of the underlying dielectric film "should be as low as possible"; and that the selectivity of the removal rate of the dielectric film ( $\text{SiO}_2$ ) should be low (preferably less than 100:1). See also Table 2 on page 3 of Sachan, et al., showing that polishing rates of Cu and  $\text{SiO}_2$  are lowered by adding polyvinylpyrrolidone (in particular, that a lowering in the polishing rate of  $\text{SiO}_2$  is remarkable). Note also paragraph [0026] on page 3 of Sachan, et al., disclosing that the addition of a component such as poly-vinylpyrrolidone (PVP) suppresses the silicon dioxide removal rate while not suppressing the copper removal rate. It is respectfully submitted that, contrary to the conclusion by the Examiner, Sachan, et

al. would have taught away from such a CMP abrasive for polishing an insulating film having unevenness on a surface thereof, including the organic polymer having an atom or structure capable of forming a hydrogen bond with a hydroxyl group present on a surface of this inorganic insulating film having unevenness on a surface thereof.

Reference by the Examiner to the Merriam-Webster Online Dictionary for a definition of “essentially”, in the expression “consisting essentially of”; and the conclusion by the Examiner therefrom that the components disclosed by Sachan, et al. are “essential”, are noted. It is respectfully submitted, however, that the expression “consisting essentially of” is a term of art in the patent law, having a meaning of excluding materials affecting the basic and novel characteristics of the claimed invention. See In re Janakirama-Rao, 317 F. 2d 951, 137 USPQ 893 (CCPA 1963). Note MPEP 2111.03. Properly construing the language of the present claims, including the “consisting essentially of” language, it is respectfully submitted that Sachan, et al., disclosing a composition including, inter alia, an oxidizing agent and a metal complexing agent, for metal CMP, would have neither taught nor would have suggested the CMP abrasive for polishing an inorganic insulating film having unevenness on a surface thereof, consisting essentially of the recited components. Again, emphasizing that Sachan, et al. discloses that the removal rate of the underlying dielectric film should be as a low as possible, relative to polishing of the metal and barrier layer, while the present CMP abrasive is for polishing the inorganic insulating film, it is respectfully submitted that Sachan, et al. would have taught away from a composition consisting essentially of and, more particularly, consisting of, the components as in the present claims.

The contention by the Examiner in the paragraph bridging pages 5 and 6 of the Office Action mailed March 15, 2006, that “it would have been obvious to one



having ordinary skill in the art at the time the invention was made to add or remove certain well known components to or from the CMP abrasive of Sachan et al in order to polish specific workpieces and to provide specific polishing results” is respectfully traversed. It is emphasized that the purpose of Sachan, et al. is to polish metal. It is respectfully submitted that by omitting certain components of the composition of Sachan, et al., as alleged by the Examiner, Sachan, et al. would have destroyed for its intended purpose. In view thereof, clearly the modification proposed by the Examiner, destroying Sachan, et al. for its intended purpose, is improper. See In re Ratti, 123 USPQ 349 (CCPA 1959).

The additional contention by the Examiner on page 6 of the Office Action mailed March 15, 2006, that removal of any components of Sachan, et al. would have been obvious since in the CMP abrasive of Sachan, et al. additional components such as oxidant and metal complexing agent “do not appear to chemically react with any of the other components”, is noted. It is respectfully submitted, however, that this analysis by the Examiner is improper under the guidelines of 35 USC §103. That is, it is respectfully submitted that the Examiner must look to the teachings of Sachan, et al., without benefit of the teachings of the present application. It is respectfully submitted that the Examiner has, improperly, made hindsight use of Applicant's disclosure in coming to a conclusion of obviousness of removing components from the composition in Sachan, et al. That the Examiner has used improper hindsight in coming to a conclusion of obviousness is especially seen in light of the purpose of the teachings of Sachan, et al., to provide a polishing composition for a metal layer with attenuation of removal of the oxide film (that is, a removal rate of the underlying dielectric film being as low as possible). Properly using the teachings of Sachan, et al. as a whole, as required under 35 USC

§102 and 35 USC §103, it is respectfully submitted that Sachan, et al. would have neither taught nor would have suggested the presently claimed CMP abrasive for polishing inorganic insulating films having unevenness on a surface thereof, consisting essentially of the components recited in the present claims.

The contention by the Examiner in lines 5-10 on page 7 of the Office Action mailed March 15, 2006, is respectfully traversed. Taking the teachings of Sachan, et al. as a whole, as required under 35 USC §103, it is respectfully submitted that Sachan, et al. teaches the reduction in the removal rate of the insulating film, and attenuation of removal thereof. It is respectfully submitted that this would have taught away from use of the composition of Sachan, et al. "to polish an oxide film", as alleged by the Examiner. It is respectfully submitted that only through hindsight use of Applicant's disclosure would one of ordinary skill in the art have either removed components of the composition of Sachan, et al. for polishing of an oxide film, or have used the composition of Sachan, et al. to polish an oxide film in the absence of a metal film. Clearly, such hindsight use of Applicant's original disclosure is improper, under the guidelines of 35 USC §103.

In view of the foregoing comments and amendments, reconsideration and allowance of all claims presently being considered on the merits in the above-identified application are respectfully requested.

To the extent necessary, applicants petition for an extension of time under 37 CFR .136. Please charge any shortage in fees due in connection with the filing of this paper to the Deposit Account of Antonelli, Terry, Stout & Kraus, LLP, Dep.

Account No. 01-2135 (Case No. 511.40998X00), and please credit any excess fees  
to such deposit account.

Respectfully submitted,

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A handwritten signature in cursive script, appearing to read "William I. Solomon", written over a horizontal line.

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